Haruki HIRABAYASHI*: **Chromosome numbers in Japanese species of *Dryopteris* (4)**

平林春樹*: 日本産オシダ属の染色体数 (4)

This is the fourth of series of papers dealing with chromosome numbers in Japanese species of *Dryopteris* (1966, 1967, 1969a). In the present paper, the author wishes to report the results of cytological observations on 26 taxa (including 2 Formosan taxa) belonging to this genus. The materials and results, together with the previous reports are listed in Table 1, under the classification by H. Ito (1939).

Sexual diploid taxa The following 7 taxa were recognized as a sexual diploid, *D. coreanomontana*, *D. polita* (Fig. 4), *D. erythrosora* var. *caudipinna* (Fig. 8), *D. laeta* (Fig. 9), *D. apiciflora* (Fig. 1), *D. hendersoni* and *D. shikokiana* (Fig. 7). Of these taxa, for *D. coreanomontana*, 82 chromosome singles separated at anaphase I in a spore mother cell were observed. It is noticeable that each of them (except *D. apiciflora*) occurs in limited areas in Japan and has remained to the primitive condition having ancestral basic number.

Apogamous diploid taxa Two taxa from Formosa, *D. paleacea* (Fig. 12) and *D. scottii* (Fig. 3) were apogamous diploid. *D. paleacea* occurs only at Sakurazima, Kagosima Pref. and *D. scottii* is not native in Japan. *D. scottii* exhibits 82 paired chromosomes and 32 large spores or 64 small spores per sporangium during sporogenesis. Since it is considered that the large spore is efficient rather than the small one at reproduction, this taxon seems to be apogamous diploid. Kurita (1966) and Mitui (1968) have reported that this taxon is sexual tetraploid. So this suggests the possibility that there are two cytotypes, i.e. apogamous diploid and sexual tetraploid in this taxon. The further work will decide this problem.

Apogamous triploid taxa The following 10 taxa proved to be apogamous triploid, *D. atrata* form. *cycadina* and *D. dickinsii* var. *namegatae* (Fig. 6) in the subsect. Cycadinae H. Ito; *D. assamensis*, *D. pacifica*, *D. erythrosora*

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Table 1. The chromosome numbers in *Dryopteris*.

Sect.	Subsect.	Species	Chromosome number	Polyploidy, hybrid & reproduction	Locality	Fig.	Previous report
Eudryopteris	Dichasium	*D. coreanomontana* Karahutomenma	n=41	sexual dipl.	Omati, Nagano Pref.	—	—
		D. uniformis form. *cristata* Sisiokumawarabi	n=82	sexual tetrapl.	*	—	—
		D. paleacea Makihiresida	n='82'	apog. dipl.	Arisan, Taiwan	12	—
		*D. scottii*** Taiwankuzyaku	n='82'	apog. dipl.	Keito, Taiwan*	3	n=82 (Kurita 1966, Mitui 1968)
		D.×fujipedis Huzikumawarabi	2n=82 (archesporial cell)	dipl. hybr.	Gotenba, Sizuoka Pref. (type plant)*	2	—
		D.×watanabei Huziosida	2n=123 meiosis irreg.	tripl. hybr.	Gotenba, Sizuoka Pref. (type plant)*	11	—
	Cycadinae	*D. atrata* form. *cycadina* Inuiwahego	n='123'	apog. tripl.	Sibisan, Kagosima Pref.*	—	—
		D. dickinsii var. *namegatae* Kiyosumiokuzyaku	n='123'	apog. tripl.	Tetuzan, Miyazaki Pref.*	6	—
		D. commixta×dickinsii Nangokuokuzyaku (named tentatively by Kurata)	2n=164 meiosis irreg.	tetrapl. hybr.	Kyusyu*	—	—
	Pycnopteris	*D. toyamae* Nagasakisidamodoki	2n=123 meiosis irreg.	tripl. cytotype ?	Kurobaruyama, Kumamoto Pref.*	10	2n=123 (Kurita, 1965, 1967, Mitui 1968)
Nephrocystis		*D. polita* Taitobenisida	n=41	sexual dipl.	Yakusima, Kagosima Pref. Coll. M. Kawabata*	4	—
		D.×yamashitae Aiinutamasida	2n=123 meiosis irreg.	tripl. hybr.	Tano, Miyazaki Pref. (type plant)*	—	—
		D. rarissima Mezurasikumawarabi	2n=164 meiosis irreg.	tetrapl. hybr.	Turuda, Kagosima Pref. (type plant)*	—	—
Polystichodrys	Erythrovariae	*D. erythrosora* var. *caudipinna* Hatizyobenisida	n=41	sexual dipl.	Hatizyozima, Tokyo Pref.*	8	—
		D. assamensis Yakusimabenisida (named tentatively by Kurata)	n='123'	apog. tripl.	Yakusima, Kagosima Pref.*	—	—
		D. erythrosora form. *prolifica* Tirimensida	n='123'	apog. tripl.	*	—	n='123' (Kurita 1966)
		D. erythrosora form. *viridisora* Midoribenisida	n='123'	apog. tripl.	Owase, Mie Pref.	—	—
		D. indusiata Nukaitatisidamodoki	n='123' (three phases)	apog. tripl.	Minamata, Kumamoto Pref.*	5	n='82' (Hirabayashi 1967) n='123' (Kurita 1967)
		D. indusiata var. *purpurascens* Murasakibenisida	n='123'	apog. tripl.	Minamata, Kumamoto Pref.*	—	n='164' (Kurita 1966)
		D. labordei var. *simasakii* Nukaitatisidamagai	n='123' (two phases)	apog. tripl.	Hongusan, Aiti Pref.*	—	—
		D. pacifica Oitatisida	n='123'	apog. tripl.	Misaki, Kanagawa Pref.*	—	—
		D. varia Nankaiitatisida	n='123'	apog. tripl.	Odawara, Kanagawa Pref.*	—	n='123' (Mitui 1966)
Lophodium	Austriacae	*D. laeta* Iwakagewarabi	n=41	sexual dipl.	Hongo, Nagano Pref. Coll. H. Okuhara	9	—
Members which were placed previously in the genus *Ctenitis*		*D. apiciflora*** Sakiminoosida	n=41	sexual dipl.	Arisan, Taiwan	1	—
		D. hendersoni Horaihimewarabi	n=41	sexual dipl.	Yakusima, Kagosima Pref.	—	n=41 (Mitui 1967)
		D. shikokiana Honokawasida	n=41	sexual dipl.	Owase, Mie Pref.	7	—

The asterisks indicate the specimen cultivated in Botanical Garden of Univ. of Tokyo. The double asterisks indicate Formosan species not native in Japan.

form. *prolifica*, *D. erythrosora* form. *viridisora*, *D. indusiata*, *D. indusiata* var. *purpurascens*, *D. labordei* var. *simasakii* and *D. varia* in the subsect. Erythrovariae H. Ito. For each of 2 taxa, *D. atrata* form. *cycadina* and *D. dickinsii* var. *namegatae* (Kurata 1958), irregular meiotic behavior was rarely found. However, it seems that this indicates not hybridity but simple abnormality, because normal meiotic behavior as shown in Fig. 6 for *D. dickinsii* var.

namegatae was mostly observed. For *D. indusiata*, the numbers of n='82' (Hirabayashi 1967) and n='123' (Kurita 1967) are given. In the present study, the numbers of n='82', '123' and '164' (Fig. 5) were observed in the same individual of this taxon. In other words, this taxon represents three phases, i. e. diploid, triploid and tetraploid. This is a phenomenon that is frequently observed in an apogamous *Dryopteris* species (Hirabayashi 1967). In the present observation, the presence of triploid phase was most frequent. Hence the number of n='123' may be regarded as the proper number for this taxon. *D. indusiata* var. *purpurascens* resembles morphologically *D. indusiata* (Kurata 1962). Cytologically, Kurita (1966) reported for this taxon the number of n='164' and to be apogamous. In the present investigation, only the number of n='123' and the sporangium having 32 viable spores were observed. Therefore, it seems that this taxon also shows two phases, triploid and tetraploid like *D. indusiata*. The number of n='123' reported here is given as a tentative determination for this taxon. For the above 2 taxa, *D. indusiata* and *D. indusiata* var. *purpurascens*, more morphological and cytological work is necessary in future.

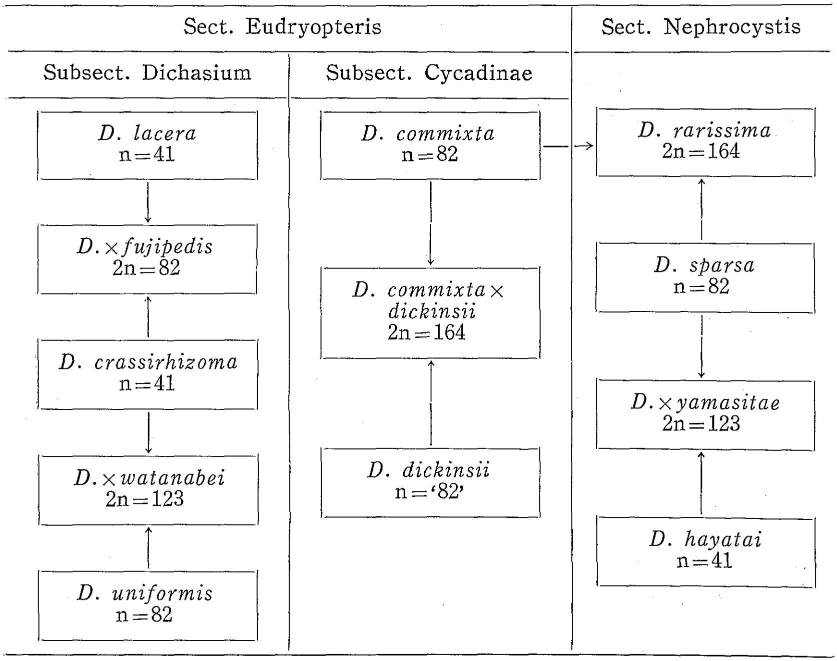
Sexual tetraploid taxon Of 26 taxa studied, only one *D. uniformis* f. *cristata* was sexual tetraploid. Since *D. uniformis*, the basic species of this form is sexual tetraploid (Kurita 1962, Hirabayashi 1966), it proved that there is no variety between the species and its form on chromosome number.

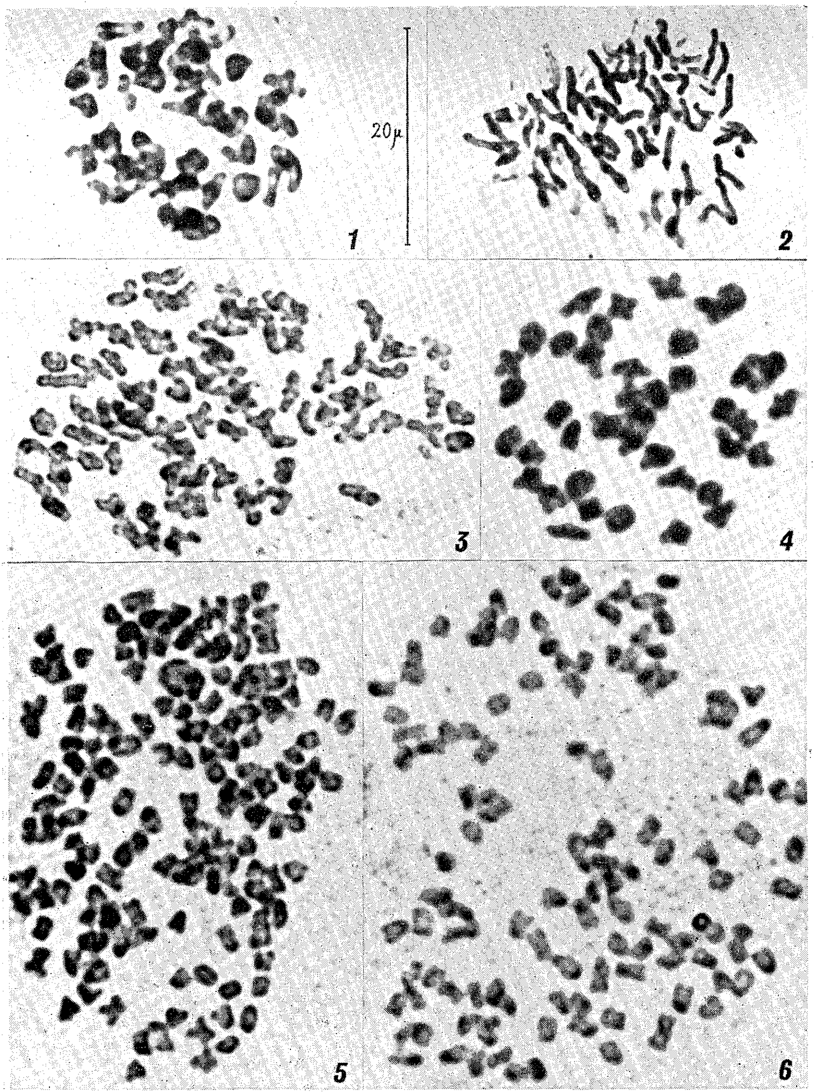
Hybrid taxa On the basis of irregular meiotic behavior showing univalents, the following 5 taxa were confirmed to be hybrid, *D.*×*fujipedis*, *D.*×*watanabei*, *D. commixta*×*dickinsii*, *D.*×*yamashitae* and *D. rarissima*. The hybridities and putative parents of these hybrids were described originally by Kurata (1964, 1965, 1969). Table 2 shows the putative parents proposed by Kurata and the chromosomal behaviors observed in the present study for these hybrids. Further Chart 1 represents a diagrammatic summary of the cytological relationships between all the taxa treated in Table 2. As obvious from this chart, there are no crosses on the chromosome numbers between the hybrids and their putative parents. Therefore, the cytological evidences support the possibilities of the actual hybridizations. Besides, for *D.*×*fujipedis*, the chromosome count was made at mitosis of an archesporial cell, because no meiosis occurred. At this mitosis, 82 somatic chromosomes were observed (Fig. 2). *D.*×*watanabei* exhibits the large number of univalents at meiosis, as shown in Fig. 11. It should be noted that *D. rarissima* may be

Table 2. The putative parents and chromosomal behavior of 5 hybrids.

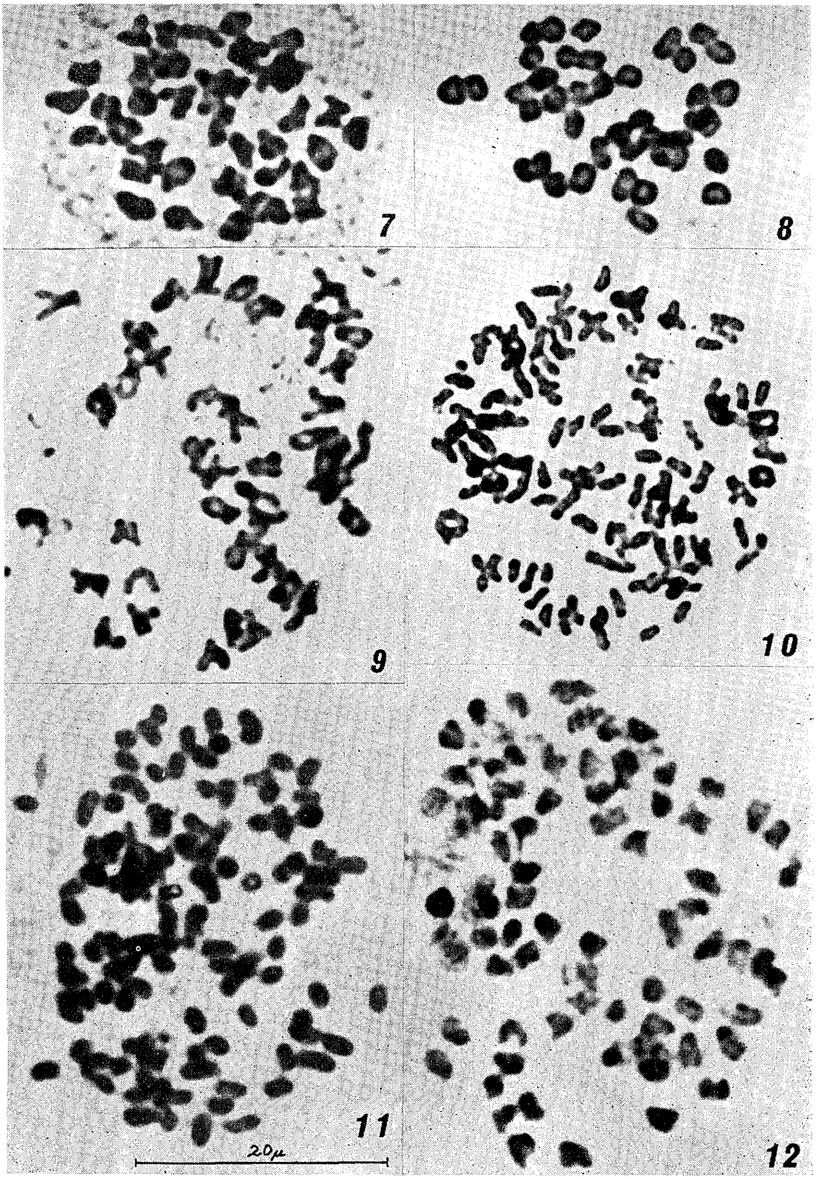
Hybrid	Putative parents	Author	Pairing behavior	Spore formation
D.×fujipedis	*D. crassirhizoma* ×*D. lacera*	Kurata (1965)	—	sterile
D.×watanabei	*D. crassirhizoma* ×*D. uniformis*	Kurata (1965)	ca. 9_{II}+ ca. 105_{I}	abortive
D. commixta×dickinsii	*D. commixta* ×*D. dickinsii*	Kurata (unpubl.)	ca. 63_{II}+ ca. 38_{I}	abortive
D. ×yamashitae	*D. hayatai* ×*D. sparsa*	Kurata (1969)	ca. 30_{II}+ ca. 63_{I}	abortive
D. rarissima	*D. commixta* ×*D. sparsa*	Kurata (1964, 1966)	ca. 58_{II}+ ca. 48_{I}	abortive

Chart 1. The cytological relationships between 5 hybrids and their putative parents studied.





Figs. 1-6. Photomicrographs of chromosomes. 1. *D. apiciflora* n=41. 2. *D.×fujipedis* 2n=82 (in archesporial cell). 3. *D. scottii* n='82'. 4. *D. polita* n=41. 5. *D. indusiata* n='164' (tetraploid phase). 6. *D. dickinsii* var. *namegatae* n='123'.



Figs. 7-12. Photomicrographs of chromosomes. 7. *D. shikokiana* n=41. 8. *D. erythrosora* var. *caudipinna* *n*=41. 9. *D. laeta* n=41. 10. *D. toyamae* 2n=123. 11. *D.* ×*watanabei* 2n=123. 12. *D. paleacea* n='82'.

an inter-section hybrid between the sect. Eudryopteris H. Ito and the sect. Nephrocystis H. Ito.

D. toyamae *D. toyamae* Tagawa (Tagawa 1939) closely resembling *D. sieboldii* O. Kuntze, is a problematic taxon about the origin. Kurita (1965) has reported the number of $2n=123$, showing approx. 30 bivalents and 63 univalents and proposed that this taxon might be a triploid hybrid between *D. sieboldii* and an unknown species. For *D. sieboldii*, the number of $n=82$ is given (Kurita 1962, Mitui 1968, Hirabayashi 1969a). Momose (1967), on the basis of irregular formation of prothallium, has considered that *D. toyamae* may be a mutant in *D. sieboldii*. In the present study for this taxon, the author also counted $2n=123$, showing approx. 35 bivalents and 53 univalents (Fig. 10) and observed abortive spore production. These facts surely indicate the possibility of hybridity of this taxon. However, a mate species of *D. sieboldii* is not given yet. Meanwhile, for *Leptorumohra miqueliana* H. Ito, the author (Hirabayashi 1969c) observed that this taxon has an intraspecific polyploidy of $2x$, $3x$ and $4x$ and the triploid cytotype shows 'n' pairs and 'n' singles at meiosis and abortive spore production and presumed this triploid that results from crossing of a diploid and a tetraploid. Then, for *D. toyamae* the author wishes to propose a supposition that this taxon may be a triploid cytotype arisen as a result of cross between a diploid and a tetraploid cytotype in *D. sieboldii*. It is expected in future that the diploid cytotype in *D. sieboldii* is detected and the chromosome figure showing exact 'n' pairs and 'n' singles in *D. toyamae* is found.

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今回扱った26種類（台湾産種2種を含む）についての結果とそれに対する考察を記すと次のとおりである。

1. n=41 の有性生殖二倍体であるもの。カラフトメンマ，タイトウベニシダ，ハチジョウベニシダ，イワカゲワラビ，サキミノオシダ（台湾産），ホウライヒメワラビおよびホオノカワシダの7種類。いずれも日本にあっては，分布が局限されているものである点に興味がもたれる。

2. n=‘82’ の無配生殖二倍体であるもの。マキヒレシダとタイワンクジャクの2種類。タイワンクジャクは栗田，三井によれば有性生殖四倍体である。筆者の観察したタイワンクジャクでは，1胞子嚢中に32個の大きな胞子をつくる場合（無配生殖）と，64個の小さな胞子をつくる場合（有性生殖）とが混在するのがみられた。配偶体形成には大きな胞子の方が有効とみられるから，無配生殖の方を有力とみたい。あるいは2種類のサイトタイプがあるのかもしれない。

3. n=‘123’ の無配生殖三倍体であるもの。イヌイワヘゴ，キヨスミオオクジャク，ヤクシマベニシダ，オオイタチシダ，チリメンシダ，ミドリベニシダ，ヌカイタチシダモドキ，ムラサキベニシダ，ヌカイタチシダマガイおよびナンカイイタチシダの10種類。ヌカイタチシダモドキでは，同一株でありながら二倍性と三倍性のほかに四倍性（n=‘164’）の胞子母細胞が混じって現われるのがみられた。この場合，三倍性母細胞がもっとも多く現われるので，n=‘123’ を正当な数とみた。一般に，オシダ属の三倍性無配生殖種には二倍性母細胞の混生がしばしばみられるが，筆者はこのような二相（ヌカイタチシダモドキでは三相）は逆に三倍性無配生殖種を特徴づけるものと考えている。ムラサキベニシダは栗田により n=‘164’ と報告されているが，本研究では n=‘123’ が算定された。よく調べればこれにも二相または三相が見出されるかもしれない。ムラサキベニシダは，形態学上からヌカイタチシダモドキにごく近いものといわれているが，細胞学的にも共に他種ではまだ観察されていない n=‘164’ の数を示す

ことは興味をよぶ。

4. n=82 の有性生殖四倍体であるもの。シシオクマワラビの1種類。品種 シシオクマワラビは母種オクマワラビと同一数の染色体をもつ。

5. 雑種性が確認されたもの。フジクマワラビ (2x), フジオシダ (3x), ナンゴクオオクジャク (4x), アイイヌタマシダ (3x) およびメズラシクマワラビ (4x) の5種類。いずれも倉田により雑種と推定されている稀産種である。各雑種とその推定両親との間には染色体数に関して食い違いはなく，その雑種説は支持されるものである。

6. ナガサキシダモドキはナガサキシダ（オオミツデ）の三倍性サイトタイプではないかと考えられること。ナガサキシダモドキは 2n=123 の三倍体で，その減数分裂および胞子形成時に，一価染色体の出現，奇形胞子形成がみられきわめて雑種的である。この種を，栗田はナガサキシダと未知種との雑種と考え，他方，百瀬は前葉体の研究からナガサキシダの突然変異型とみた。筆者は昨年，ナライシダで，これに 2x, 3x および 4x の3種類のサイトタイプがあり，このうち二倍体と四倍体の交雑によって生じたと思われる三倍体が，細胞学的に明瞭な雑種的諸相を示すのを観察した。ナガサキシダモドキの場合も，この三倍体ナライシダの場合との類似性を思わせるし，しかもその片親に妥当する種がまだ発見されていないことも考えあわせると，そこには，ナガサキシダモドキはナガサキシダ（n=82 の四倍体だけで，二倍体は見付かっていないが）の三倍性サイトタイプであると考えられる余地があるものとおもわれる。

○チシマザクラの別和名（久内清孝） Kiyotaka Hisauchi: On the Japanese name for *Prunus nipponica* var. *kurilensis* Wilson.

エトロフザクラという名がチシマザクラの別名であることは知れわたっていることで，いまさら話題にする価値も必要もないことだが．この称呼は北海道の方では古くから用いられたようで，北海道系統の本，たとえば北海道主要樹木図譜 (1927)，また最近の出版にかゝる北方植物園（朝日新聞社編）などにも，別名としてであるが用いてある。この名は植物総覧第一版 (1925) 以後の名彙類ではたいていのっている。そのためこの名を知らない人はないようである。しかし，この名は相当に古くから用いられているものらしい。だから先占権がどれにあるとかないとか，そんなつまらないことにものいいをつけようとするのではなく，たゞ古くこんな呼名もあったというだけのことである。さてそのよりどころは屋代弘賢の古今要覧稿（文化 14 ?）にこの図がのせてあることを知ったからである。この本の原本は見られないから見ていないが図書刊行会本によってのことである。そうしてこの図をチシマザクラと見てよいなら，このエトロフザクラは同一物と思う。もしそれでよいなら江戸で文化十二年四月二十八日に咲いたことになる（念八日の念は廿のことだとなっているから 28 日とよむ）。当時すでにエゾとは交通があったが松浦竹四郎のような人が種子をもってきたのかもしれない。